DEPARTMENT OF THE ARMY

EUROPE DIVISION, CORPS OF ENGINEERS

APO 09757

ENERGY ENGINEERING ANALYSIS PROGRAM

NATO SHAPE SUPPORT GROUP NSSG (US), BE

BE 010 CHIEVRES AIR BASE

BE 015 DAUMERIE KASERNE

BE 020 STERREBEEK DEP SCHOOL

BE 031 HOOGBUUL STORAGE FACILITY

EXECUTIVE SUMMARY

1 MAY 1984

PREPARED BY

LEO A. DALY

PLANNING/ARCHITECTURE/ENGINEERING

8600 INDIAN HILLS DRIVE

OMAHA, NEBRASKA 68114, USA

IN ASSOCIATION WITH

HANS DONGES

INGENIEUR-BURO

KARLSTRASSE 25

6301 BIEBERTAL, FRG

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

19971016 021

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)
GLOSSARY OF TERMS AND ABBREVIATIONS
ENERGY REPORT

AAFES	-	ARMY AIR FORCE EXCHANGE SERVICE
ADMIN	-	ADMINISTRATION
AFCENT	-	ALLIED FORCES CENTRAL
AHU	-	AIR HANDLING UNIT
ASG	-	AREA SUPPORT GROUP
ASHRAE	-	AMERICAN SOCIETY OF HEATING, REFRIGERATION, AND AIR CONDITIONING ENGINEERS, INC.
AVG	-	AVERAGE
BAR	-	BAR: 14.5 PSI
BE	-	BELGIUM
BEQ	-	BACHELOR ENLISTED QUARTERS
BF	-	BELGIUM FRANC
BKS	-	BARRACKS
BLDG	-	BUILDING
BOQ	-	BACHELOR OFFICER'S QUARTERS
BTU	-	BRITISH THERMAL UNIT: A HEAT UNIT EQUAL TO THE AMOUNT OF HEAT REQUIRED TO RAISE ONE POUND OF WATER ONE DEGREE FAHRENHEIT.
BTU/HR OR BTUH	-	BRITISH THERMAL UNITS PER HOUR
C	-	CELSIUS
C & D	-	CHIEVRES & DAUMERIE
CFH	-	CUBIC FEET PER HOUR
CFM	-	CUBIC FEET PER MINUTE
CMU	-	CONCRETE MASONRY UNIT (BLOCK)
COMM	-	COMMISSARY

COMTY	-	COMMUNITY
CUFT	-	CUBIC FOOT
DA	-	DEPARTMENT OF THE ARMY
DD	-	DEGREE DAY: THE DIFFERENCE BETWEEN THE AVERAGE TEMPERATURE FOR A DAY AND 65° F.
DEH	-	DIRECTOR OF ENGINEERING AND HOUSING
DG	-	DUTCH GUILDER
DHW	-	DOMESTIC HOT WATER
DM	-	DEUTSCHE MARK
DOE	-	DEPARTMENT OF ENERGY
ECIP	-	ENERGY CONSERVATION INVESTMENT PROGRAM
ECO	-	ENERGY CONSERVATION OPPORTUNITY
ECOS	-	ENERGY CONSERVATION OPPORTUNITIES
EEAP	-	ENERGY ENGINEERING ANALYSIS PROGRAM
EFF	-	EFFICIENCY
EMCS	-	ENERGY MONITORING AND CONTROL SYSTEM
ESIR	-	ENERGY SAVINGS-TO-INVESTMENT RATIO
ESP	-	ENERGY SIMULATION PROGRAM
EUD	-	EUROPE DIVISION, CORPS OF ENGINEERS
F	-	FAHRENHEIT
FG	-	FIBERGLASS
FH	-	FAMILY HOUSING
FLUO	-	FLUORESCENT
FO	-	FUEL OIL
FRG	-	FEDERAL REPUBLIC OF GERMANY (WEST GERMANY)
FT	-	FEET
FUNC	-	FUNCTION
FY	-	FISCAL YEAR

Glossary of Terms and Abbreviations (continued)

GAL	-	GALLON
GPM	-	GALLONS PER MINUTE
GWB	-	GYPSUM WALL BOARD
GY AREA	-	GERMANY (GY) AREA
HGT	-	HEIGHT
HVAC	-	HEATING, VENTILATING, AIR CONDITIONING
KASER	-	KASERNE
KW	-	KILOWATT, 1000 WATTS
KWHR	-	KILOWATT HOUR
LAB	-	LABORATORY
LF	-	LINEAL FOOT
M	-	METER
M3	-	CUBIC METERS
MAN	-	MANUAL
MBTU	-	ONE MILLION BRITISH THERMAL UNITS
MEGA	-	MILLION
MH/MH	-	MAN-HOUR
MM	-	MILLIMETER
MO	-	MONTH
M & R	-	MAINTENANCE AND REPAIR
MUX	-	MULTIPLEX
MW	-	MEGAWATT, ONE MILLION WATTS
MWH	-	MEGAWATT-HOUR, ONE MILLION WATT-HOUR
MWHR	-	MEGAWATT-HOUR, ONE MILLION WATT-HOUR
MWHRS	-	MEGAWATT-HOUR, ONE MILLION WATT-HOURS
NATO	-	NORTH ATLANTIC TREATY ORGANIZATION
N/A	-	NOT APPLICABLE; NOT AVAILABLE

Glossary of Terms and Abbreviations (continued)

NBS	-	NATIONAL BUREAU OF STANDARDS
NE	-	NETHERLANDS
NL	-	NETHERLANDS
NOAA	-	NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NO.	-	NUMBER
NSSG	-	NATO SHAPE SUPPORT GROUP
OA	-	OUTSIDE AIR
OCCUP	-	OCCUPANCY
OH	-	OVERHEAD
OPER	-	OPERATIONS
O & M	-	OPERATION AND MAINTENANCE
PF	-	POWER FACTOR; RELATIONSHIP BETWEEN KW AND KVA. WHEN THE POWER FACTOR IS UNITY, KVA EQUALS KW.
PF	-	PFENNING
POMCUS	-	PREPOSITIONED MATERIAL CONFIGURED TO UNIT SETS
PSI(A)(G)	-	POUNDS PER SQUARE INCH (ABSOLUTE)(GAUGE)
PX	-	POST EXCHANGE
R-VALUE	-	THE RESISTANCE TO HEAT FLOW EXPRESSED IN UNITS OF (SQUARE FEET)(HOUR)(DEGREE F.)/BTU; R VALUE - 1/U VALUE.
SA	-	SUPPORT ACTIVITY
SF	-	SQUARE FOOT
SHAPE	-	SUPREME HEADQUARTERS ALLIED POWERS EUROPE
SIR	-	SAVINGS-TO-INVESTMENT RATIO: TOTAL LIFE CYCLE BENEFITS DIVIDED BY 90 PERCENT OF THE DIFFERENTIAL INVESTMENT COST.
SIOH	-	SUPERVISION, INSPECTION AND OVERHEAD
SOS	-	STATEMENT OF SERVICES
SP	-	SINGLE PANE
STY	-	STORY
TRY	-	TEST REFERENCE YEAR

Glossary of Terms and Abbreviations (continued)

'U' VALUE	-	A COEFFICIENT EXPRESSING THE THERMAL CONDUCTANCE OF A COMPOSITE STRUCTURE IN BTU PER (SQUARE FOOT) (HOUR) (DEGREE F. TEMPERATURE DIFFERENCE)
UA	-	OVERALL HEAT TRANSFER COEFFICIENT (BTU/HR DEGREE F.)
UPW	-	UNIFORM PRESENT WORTH FACTOR: A FACTOR, WHICH WHEN APPLIED TO ANNUAL SAVINGS, WILL ACCOUNT FOR THE TIME VALUE OF MONEY AND INFLATION OVER THE LIFE OF THE PROJECT.
US	-	UNITED STATES
USAREUR	-	UNITED STATES ARMY; EUROPE
V	-	VOLT
VET	-	VETERINARY
W	-	WATT
WDW	-	WINDOW
WHSE	-	WAREHOUSE
WK	-	WEEK
YR/yr	-	YEAR

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Scope.

This Summary outlines documents the information compiled during Phase II of Contract DACA 90-83-C-0013, "Energy Engineering Analysis Program." The purpose of the contract is to reduce energy consumption in the community by identifying actions and/or projects that will accomplish this end. The contract is divided into three phases:

1.1.1. Phase I - Data Gathering.

During this phase, data was compiled describing the pertinent features of energy consuming facilities and past history of energy consumption. This data is contained in the "Data Report" dated 15 April 1983.

1.1.2 Phase II - Data Analysis.

During this phase, the data collected in Phase I was analyzed. Energy conservation opportunities (ECOS) were identified and economically analyzed. The "Energy Report" presents recommendations, justifications, and preliminary DD Form 1391s.

1.1.3. Phase III - Project Documents.

During this phase, applicable DA Form 4283s, DD Form 1391s, and Project Development Brochures will be prepared.

1.2. General Description

NSSG (US) has eight (8) installations and two (2) major lease holdings. Seven (7) installations and one leased facility are located in south and central Belgium and one installation and one leased facility are in the Rotterdam area of the Netherlands. Only four (4) of NSSG's installations

are included in this study. These are BE 010 Chievres Air Base, BE 015 Daumerie Kaserne, BE 020 Sterrebeek Dependent School, and BE 031 Hoogbuul Storage Facility.

1.2.1. Location.

BE 010 Chievres Air Base is located in southern Belgium about 40 miles (64.4 km) southwest of Bruxelles and 11 miles (17.7 km) northwest of the SHAPE complex.

BE 015 Daumerie Kaserne is located immediately northwest of Be 010 Chievres Air Base.

BE 020 Sterrebeek Dependent School is located in the village of Sterrebeek, a suburb east of Bruxelles.

BE 031 Hoogbuul Storage Facility is located near Herentals (east of Antwerpen.

1.2.2. Climate.

All of NSSG (US) facilities under consideration are located in the Belgium lowlands. Summers are cool and winters are mild. The area is overcast much of the year and precipitation is frequent usually in the form of light rain showers. Although Chievres Air Base is only 50 miles northwest of the Ardenne, at an elevation of 200 feet, it is climatologically related to the lowlands to the north. Chievres AIr Base is included in TM 5-785 "Engineering Weather Data".

1.2.3. Facilities.

The major buildings at Chievres are six (6) large concrete frame hangars with concrete roofs and masonry walls. Two (2) are still used for aircraft operation. The other four (4) have been extensively modified and house the commissary, post exchange, supply storage, vehicle maintenance and the facilities engineers function. Generally, heating

is provided by individual oil-fired boilers. There is no air conditioning except a few isolated window units in snack bars, etc. Non-warehouse portions of these facilities have been provided with insulating suspended ceilings. Several relatively new buildings are constructed of insulated metal panels. The remaining buildings are generally of either brick or concrete.

Daumerie Kaserne is a group of relatively small brick buildings with steeply sloping roofs, built during World War II by the Germany Army to resemble the nearby town of Chievres. Heating is provided by individual oil-fired boilers. There is no air conditioning except for some small units serving computers and communications equipment.

Sterrebeek Dependent School was constructed by the US Government in 1968 and consists of two (2) classroom buildings, a gymnasium, multipurpose building (dining, admin.) and a health clinic. These buildings were all constructed of precast concrete and masonry. All buildings are insulated.

Hoogbuul Storage Facility facilities include four (4) controlled-humidity storage warehouse, a maintenance facility, and small office buildings. The large warehouses are unheated. They are all constructed of uninsulated corrugated metal. The maintenance building is concrete with a metal roof.

2. EXISTING ENERGY SITUATION

2.1. Baseline FY 75 Energy Consumption.

ELECTRICITY	KWHRS	MBTU (RAW SOURCE)*
Chievres and Daumerie	1,341,300	15,559
PX and Commissary	1,621,820	18,813
Sterrebeek	357,840	4,150
Hoogbuul	Did Not Exist	
TOTAL	3,320,960	38,522

FUEL OIL	US GAL	MBTU
Chievres	310,678	45,670
Daumerie	36,796	5,410
Sterrebeek	49,933	7,340
Hoogbuul	Did Not Exist	
TOTAL	397,407	58,420

* 11,600 BTU/KWHR represents fuel input at generating plant.

2.2. Source Energy Consumption.

In FY 82, NSSG (US) purchased approximately US $700,000 worth of electricity and fuel oil at the 4 locations surveyed. This represents approximately US $1 per gross square foot of space. Fuel oil consumed was 426,688 US GAL or 62,719 million BTU or (122,000 BTU/SF of heated space). Electricity use amounted to 4,644,006 KWHRS or 53,870 million BTU. (81,129 BTU/SF)

Cost data was obtained from Mr. Hindricq. Electricity is 2.862 Belgian Francs per KWH. In 1982, fuel oil cost 11.6 BF/Liter. In 1983, oil cost has risen to 12.39 BF/Liter.

In US$, at 47 BF/US$, 1982 commodity prices were $.06/KWH and $.98/US gallon. Based on the tabulated consumption figures FY 82 costs calculated to be:

FUEL OIL	BELGIAN FRANCS	US $ (AT 47 BF/$)
Chievres	12,968,520	275,925
Daumerie	3,650,728	77,675
Sterrebeek	2,476,600	52,693
Hoogbuul	591,000	12,587
TOTAL	19,686,830	418,880

ELECTRICITY	BELGIAN FRANCS	US $ (AT 47 BF/$)
Chievres	5,949,067	126,575
PX & Commissary	4,862,246	103,452
Sterrebeek	1,058,940	22,530
Hoogbuul	1,420,891	30,231
TOTAL	13,291,144	282,788

TOTAL COSTS	BELGIAN FRANCS	US $ (AT 47 BF/$)
Oil	19,686,830	418,880
Elec	13,291,144	282,788
TOTAL	32,977,974	701,668

2.3. Present Annual Energy Consumption (FY 82).

All heating at the four locations surveyed utilized fuel oil. Hoogbuul and Sterrebeek each have a single electric meter. At Chievres, one

electric meter serves the PX and Commissary activities. This includes Buildings 4, 5, 84, and 81. Another meter serves the remainder of Chievres Air Base and Daumerie Kaserne.

Consumption of oil and electricity for the fiscal years available is tabulated as follows:

ELECTRICITY	KWHRS	MBTU (RAW SOURCE)*
Chievres and Daumerie	2,078,640	24,112
PX and Commissary	1,698,898	19,707
Sterrebeek	370,000	4,292
Hoogbuul	496,468	5,759
TOTAL	4,644,066	53,870

* 11,600 BTU/KWHR represents fuel input at generating plant.

FUEL OIL	US GAL	MBTU
Chievres	282,316	41,500
Daumerie	79,474	11,682
Sterrebeek	52,020	7,644
Hoogbuul	12,878	1,893
TOTAL	426,688	62,719

2.4. Existing Building Source Energy Consumption.

Heating demand and consumption has been estimated for each of the buildings. The losses for each building are shown in Tables 2-1 thru 2-4. HLWALL, HLROOF, HLGLAS, HLDOOR, TOTHLOS are the wall, roof, window, door, and total peak heat losses in BTUH based on an outdoor design condition of 21^{0} F. and an indoor condition of 68^{0} F. ANUALHT is the estimated annual heating requirement in millions of BTUS. HTPSFYR is the annual heating

requirement per square foot of building area. These are heating requirements and not fuel consumption.

Table 2-1. Building Heat Loss, Chievres

BLDG	HLWALL	HLROOF	HLGLAS	HLDOOR	TOTHLOS	ANUALHT	HTPSFYR
01	3,092	58,656	49,663	38,954	150,366	474	14,212
02	18,552	351,936	297,978	233,729	902,196	2,882	86,316
03	99,083	351,936	223,530	7,060	681,610	2,178	65,212
04	151,262	498,576	284,763	15,611	950,213	3,020	90,440
05	207,891	498,576	184,876	10,890	902,235	2,868	85,874
06	27,735	416,355	239,292	164,600	847,983	2,611	51,822
09	72,289	44,668	24,474	44,913	186,346	588	89,884
10	105,868	20,537	12,436	91,332	230,175	731	99,635
12	66,662	68,624	33,837	31,301	200,426	640	119,310
22	71,585	31,941	19,263	16,480	139,271	439	83,589
23	77,695	31,941	22,683	5,320	137,641	434	82,610
24	87,463	34,522	60,489	16,480	198,955	628	85,339
25	81,913	23,943	24,418	2,956	133,232	410	128,880
27	12,480	51,647	21,269	1,644	87,041	268	66,357
28	12,339	51,647	22,675	1,644	88,307	271	67,323
29	12,480	51,647	22,675	1,644	88,447	272	67,429
30	10,199	32,279	15,600	3,629	61,709	190	47,045
31	7,626	24,304	17,073	2,956	51,961	160	39,613
32	11,916	60,761	26,677	1,934	101,290	322	79,703
33	9,861	32,279	17,050	3,699	62,891	199	49,487
34	9,777	51,647	21,269	5,235	87,929	280	69,548
47	48,433	102,460	60,075	2,901	213,870	658	151,082
52	46,394	316,817	74,861	70,277	508,351	1,624	192,788
56	132,250	87,161	63,952	26,615	309,980	883	133,808

TOTAL KASERNE ANUALHT IN MILLION BTUS	23,041
TOTAL KASERNE SQUARE FEET	309,426
AVERAGE ANNUAL BTU/SF	85,304
PEAK HEAT LOSS IN BTU	7,322,434

Table 2-2. Building Heat Loss, Daumerie

BLDG	HLWALL	HLROOF	HLGLAS	HLDOOR	TOTHLOS	ANUALHT	HTPSFYR
01		146,945			146,945	452	72,377
02	21,674	52,640	11,167	483	85,965	244	109,330
03		117,597		943	118,541	376	48,195
04		58,706			58,706	187	63,829
05	28,303	56,689	9,096	411	94,500	301	106,404
07	82,193	218,366	32,123	2,349	335,032	1,065	97,426
08	100,763	158,801	40,033	2,466	302,065	860	54,789
09	19,253	37,647	8,168	552	65,621	208	130,215
10	50,508	145,465	27,194	1,450	224,618	691	111,760
11	20,157	38,352	6,064	391	64,965	200	104,214
13	54,947	106,302	21,738	1,179	184,168	585	82,833
14	13,779	32,666	6,551	353	53,351	164	75,654
15	22,014	57,807	9,096	391	89,309	283	98,104
16	22,108	51,112	8,013	460	81,695	251	115,680
18	24,015	57,997	8,454	1,237	91,704	282	90,412
19	22,705	53,541	9,884	436	86,567	266	92,450
20	96,780	155,946	51,421	1,528	305,675	971	52,076
22	21,450	39,691	12,511	552	74,206	228	135,308
24	103,148	130,754	84,271	2,901	321,074	1,105	60,758

TOTAL KASERNE ANUALHT IN MILLION BTUS	8,730
TOTAL KASERNE SQUARE FEET	117,300
AVERAGE ANNUAL BTU/SF	89,569
PEAK HEAT LOSS IN BTU	2,784,715

Table 2-3. Building Heat Loss, Sterrebeek

BLDG	HLWALL	HLROOF	HLGLAS	HLDOOR	TOTHLOS	ANUALHT	HTPSFYR
A	79,540	241,758	151,067	17,636	490,002	1,509	58,680
C	44,823	90,296	190,307	4,658	330,086	1,049	51,816
D	56,808	87,194	73,310	6,987	224,301	713	76,870
E	62,138	64,907	49,683	1,663	178,393	566	82,087
B	44,823	90,296	190,307	4,658	330,086	1,049	51,816

TOTAL KASERNE ANUALHT IN MILLION BTUS	4,887
TOTAL KASERNE SQUARE FEET	82,392
AVERAGE ANNUAL BTU/SF	64,253
PEAK HEAT LOSS IN BTU	1,552,871

Table 2-4. Building Heat Loss, Hoogbuul

BLDG	HLWALL	HLROOF	HLGLAS	HLDOOR	TOTHLOS	ANUALHT	HTPSFYR
14	152,569	155,261	29,091	71,748	408,670	1,305	233,197

TOTAL KASERNE ANUALHT IN MILLION BTUS	1,305
TOTAL KASERNE SQUARE FEET	5,600
AVERAGE ANNUAL BTU/SF	233,197
PEAK HEAT LOSS IN BTU	408,670

Converting to fuel consumption at 70 percent plant efficiency yields the following comparison of calculated versus actual consumption:

LOCATION	ACTUAL	CALCULATED	ACTUAL/CALCULATED
Chievres Air Base	41,500	32,915	1.26
Daumerie	11,682	12,471	0.93
Sterrebeek	7,644	6,981	1.09
Hoogbuul	1,893	1,865	1.02

The differences in actual versus calculated can be explained as follow:

- Chievres Air base has a number of boiler plants with an efficiency of less than 70 percent. Calculations are based on plants being improved to a seasonal efficiency of 70 percent so as to not over-estimate savings due to weatherization and improvement in temperature control systems. Other factors that cause under-estimation of fuel used is the lack of ability to estimate the degree of reheat required in the commissary and the use of a large warehouse or hangar doors. Guesstimates for these values would cause over-estimation of savings due to other improvements and are, therefore, not included.

- Daumerie Kaserne has been apparently over-estimated. Several buildings are, however, only heated during part of the winter at present. Implementation of the future development plan will change this. If the consumption of Building 3, 7 and 24 are eliminated, the consumption would in fact be underestimated by 16 percent. This again is caused by the poor efficiencies of some of the heating plants.
- Sterrebeek Dependent School has been underestimated only by consumption of domestic hot water used in the kitchen of the school and the health clinic.

3. ENERGY CONSERVATION OPPORTUNITIES DEVELOPED

3.1. ECOS Investigated.

3.1.1. Weatherization Projects.

Evaluation of ECOs relating to building envelope, HVAC and lighting resulted in the following project qualifying under ECIP criteria:

PROJECT DESCRIPTION	COST	ANNUAL SAVINGS (MBTU)	ANNUAL SAVINGS US$	SIR
Weatherization Walls and Roofs	$905,495	19,849	141,324	1.7

During a field survey of the community, ten (10) different types of walls and ten (10) different types of roofs were identified. Each wall and roof type was analyzed and a modification for each was proposed to (wherever practical) achieve "U" factors required by current criteria. Cost estimates were developed for each modification. Unit prices and revised "U" factors were used to compute costs and savings. All modifications having a SIR less than 1.0 were eliminated.

The wall and roofs modifications having SIRs equal to or greater than one (1) are shown in Tables 3-1 and 3-2 respectively. While wall and roof insulation has been combined into a single insulation project, walls and roofs in the same building do not necessarily always qualify economically and therefore are listed separately.

	Heat MBTU	Fuel*
Savings -		
Walls	1,682	2,402
Roofs	12,213	17,447
TOTAL	13,895	19,849

* Fuel consumption based on 70 percent plant efficiency.

Cost -

Walls	$ 145,806
Roofs	759,689
TOTAL	$ 905,495

SIR = 1.77

Table 3-1. Savings Weatherization Walls, NSSG

BLDG	KASERNE	FUNC	WALL TYPE	SQFT BLDG	SAVINGS MBTU	SAVINGS US$	COST US$	SIR	FUEL TYPE	SQFT WALL
09	BE 010	PX WAREHOUS	MAS1	6,545	199	23,026	20,447	1.12	NO 2	5,893
10	BE 010	FIRE STATIO	MAS1	7,344	166	19,176	15,853	1.20	NO 2	4,569
12	BE 010	VECH. MAINT	MAS1	5,368	98	11,378	9,982	1.13	NO 2	2,877
22	BE 010	HOUSING STO	CON1	5,260	235	27,237	19,394	1.40	NO 2	3,679
23	BE 010	FOOD STORAG	CON1	5,260	255	29,562	21,050	1.40	NO 2	3,993
24	BE 010	HSING.OFF.S	CON1	7,360	288	33,278	23,696	1.40	NO 2	4,495
25	BE 010	SUPPLY DIV.	CON1	3,184	197	22,805	15,604	1.46	NO 2	2,960
14	BE 031	MAINT.SHOP	CON3	5,600	241	27,883	19,777	1.40	NO 2	5,700

TOTAL ANNUAL HEAT SAVINGS MBTU	1,682
TOTAL DOLLAR SAVINGS	194,347
TOTAL COST	145,806
TOTAL SQFT	45,921
TOTAL SQFT WALLS	34,166
PEAK LOAD REDUCTION	532,897

Table 3-2. Savings Weatherization Roofs, NSSG

BLDG	KASERNE	FUNC	ROOF TYPE	SQFT BLDG	SAVINGS MBTU	SAVINGS US$	COST US$	SIR	FUEL TYPE	SQFT ROOF
01	BE 010	HANGAR	CON2	33,400	763	88,225	82,986	1.06	NO 2	39,000
02	BE 010	HANGAR	CON2	33,400	773	89,301	82,986	1.07	NO 2	39,000
03	BE 010	WAREHOUSE	CON2	33,400	773	89,301	82,986	1.07	NO 2	39,000
04	BE 010	POST EXCH.	CON5	33,400	1,006	116,299	91,584	1.26	NO 2	39,000
05	BE 010	COMMISSARY	CON5	33,400	1,006	116,299	91,584	1.26	NO 2	39,000
06	BE 010	ADMIN.& MAI	CON5	50,399	1,082	124,971	101,576	1.23	NO 2	43,255
09	BE 010	PX WAREHOUS	CON2	6,545	129	14,930	14,043	1.06	NO 2	6,600
12	BE 010	VECH.MAINT.	CON2	5,368	106	12,291	11,422	1.07	NO 2	5,368
22	BE 010	HOUSING STO	ASB1	5,260	102	11,802	5,095	2.31	NO 2	6,041
23	BE 010	FOOD STORAG	ASB1	5,260	102	11,802	5,095	2.31	NO 2	6,041
24	BE 010	HSING.OFF.S	ASB1	7,360	110	12,755	5,507	2.31	NO 2	6,529
25	BE 010	SUPPLY DIV.	ASB1	3,184	56	6,473	2,685	2.41	NO 2	3,184

Table 3-2. Savings Weatherization Roofs, NSSG (continued)

BLDG	KASERNE	FUNC	ROOF TYPE	SQFT BLDG	SAVINGS MBTU	SAVINGS US$	COST US$	SIR	FUEL TYPE	SQFT ROOF
27	BE 010	BASE OPER.	ATT3	4,040	97	11,239	3,407	3.29	NO 2	4,040
28	BE 010	BASE OPER.	ATT3	4,040	97	11,239	3,407	3.29	NO 2	4,040
29	BE 010	PROP.BOOK O	ATT3	4,040	97	11,239	3,407	3.29	NO 2	4,040
30	BE 010	VET.CLINIC	ATT4	4,040	56	6,484	3,407	1.90	NO 2	4,040
31	BE 010	4 SEA.STORE	ATT4	4,040	56	6,484	3,407	1.90	NO 2	4,040
32	BE 010	FURN.STORE	ATT3	4,040	100	11,601	3,407	3.40	NO 2	4,040
33	BE 010	MULTI-USE	ATT4	4,040	57	6,693	3,407	1.96	NO 2	4,040
34	BE 010	AUTO PARTS	ATT3	4,040	94	10,932	3,407	3.20	NO 2	4,040
47	BE 010	OIC,LOG.PRO	ATT1	4,360	173	20,061	3,677	5.45	NO 2	4,360
52	BE 010	BODY SHOP	CON1	8,426	531	61,388	14,860	4.13	NO 2	8,426
56	BE 010	CONTROL TOW	ATT1	6,600	136	15,786	3,128	5.04	NO 2	3,709
01	BE 015	ADMIN. & JA	ATT1	6,253	249	28,771	5,274	5.45	NO 2	6,253
02	BE 015	XMTR	ATT1	2,240	82	9,533	1,889	5.04	NO 2	2,240
03	BE 015	REC. CTR.	ATT1	7,819	321	37,134	6,595	5.63	NO 2	7,819
04	BE 015	LGM MAINT.	ATT1	2,939	113	13,153	2,478	5.30	NO 2	2,939
05	BE 015	F.E.MAINT.	ATT1	2,838	109	12,701	2,393	5.30	NO 2	2,838
07	BE 015	COMM. CTR.	ATT1	10,932	449	51,917	9,220	5.63	NO 2	10,932
08	BE 015	COMP.& EDU.	ATT1	15,707	292	33,836	6,705	5.04	NO 2	7,950
09	BE 015	COMM.COUNSE	ATT1	1,602	65	7,608	1,351	5.63	NO 2	1,602
10	BE 015	DENTAL CLIN	ATT1	6,190	246	28,481	5,221	5.45	NO 2	6,190
11	BE 015	OIC CAD D/L	ATT1	1,920	76	8,834	1,619	5.45	NO 2	1,920
13	BE 015	CHAPEL	ATT1	7,068	290	33,567	5,961	5.63	NO 2	7,068
14	BE 015	DET 2,1964C	ATT1	2,172	86	9,994	1,832	5.45	NO 2	2,172
15	BE 015	ARMY COMM.S	ATT1	2,894	118	13,744	2,441	5.63	NO 2	2,894
16	BE 015	TECH.CONTRO	ATT1	2,175	86	10,008	1,834	5.45	NO 2	2,175
18	BE 015	128 SIG.DET	ATT1	3,124	124	14,374	2,635	5.45	NO 2	3,124
19	BE 015	DIAL CENT.O	ATT1	2,884	114	13,269	2,432	5.45	NO 2	2,884
20	BE 015	COMMUN. CTR	ATT1	18,660	345	39,893	7,085	5.63	NO 2	8,400
22	BE 015	CHIEFS SUPP	ATT1	1,689	67	7,771	1,424	5.45	NO 2	1,689
24	BE 015	EMERG.BILLI	ATT1	18,194	286	33,090	4,693	7.05	NO 2	5,564
A	BE 020	ADMIN.	ATT4	25,719	357	41,281	21,693	1.90	NO 2	25,719
B	BE 020	HIGH SCHOOL	ATT4	20,246	137	15,914	8,102	1.96	NO 2	9,606
C	BE 020	GRADE SCHOO	ATT4	20,246	137	15,914	8,102	1.96	NO 2	9,606
D	BE 020	GYMNASIUM	ATT4	9,276	133	15,367	7,824	1.96	NO 2	9,276
E	BE 020	HEALTH CLIN	ATT4	6,905	99	11,439	5,824	1.96	NO 2	6,905
14	BE 031	MAINT.SHOP	CON1	5,600	306	35,393	8,567	4.13	NO 2	4,858

TOTAL ANNUAL HEAT SAVINGS MBTU	12,213
TOTAL DOLLAR SAVINGS	1,410,605
TOTAL COST	759,689
TOTAL SQFT	507,374
TOTAL SQFT ROOFS	473,456
PEAK LOAD REDUCTION	3,883,218

3.1.2. Mechanical Control.

Mechanical control changes considered included replacing manual radiator valves with thermostatic valves, night setback of heating and ventilating equipment and night setback of domestic hot water equipment.

Because of the relative few number of buildings which may accommodate these improvements, the total project costs were less than $200,000 in each case and therefore failed to qualify for ECIP. Funding for these projects may however, be accomplished through the Military Community Authority. Therefore, documentation for mechanical improvements may be found in Section 3.3.

3.1.3. Boiler Plants and Distribution Systems.

Because projects developed had investment requirements less than $200,000, they did not qualify under ECIP and are included in Section 3.3.

3.1.4. Energy Monitoring and Control System

3.1.4.1. General.

The feasibility of installing on Energy Monitoring and Control System (EMCS) for the Chievres Air base/Daumerie Kaserne complex was investigated as part of this study.

The Master Control Room (MCR) is proposed to be located in Building 6 at Chievres Air Base, the Facilities Engineering and Maintenance building. The system would have 18 field interface devices (FIDs) located in Strategic buildings on Chievres Air Base and Daumerie Kaserne. The buildings without FIDs would contain multiplexers (MUXs). The entire system would be connected together with underground coaxial cable. All buildings would be monitored for temperature, equipment operation, and lighting control. The system has been estimated at 825 points and thus will be classified as a medium sized system.

3.1.4.2. Software Functions.

The following software functions have been selected for the EMCS on the basis that local controls have first and EMCS has second priority.

This means that the savings gains by EMCS are based on the annual heating consumption after the deduction of those savings gained by local controls.

3.1.4.3. Scheduled Start/Stop.

Function will not result in any further energy savings, other than those already gained by local controls.

3.1.4.4. Summary/Winter Operation.

This function will shut down the heating systems during periods when the outdoor temperature is above 59^{o} F. (15^{o} C.). Based on a computer simulation, a savings of 3.5 percent annual heating energy savings could be realized.

3.1.4.5. Optimum Start/Stop.

Experience has shown that this function will result in additional annual shut-off periods of approximately 0.5 hours/day over the year, which results in 183 hours/year, with an annual heating savings constant of:

3.5%/2,394 x 183 hours = 0.27 percent

The electrical energy savings constant for shut-off of each hot water circulating pump will be:

183 HRS x 0.75 kW = 137 kWh/YR

For each heating and ventilating unit fan, the electrical savings constant for shut-off will be:

183 hrs x 5 kW = 915 kWh/YR

3.1.4.6. Duty Cycle.

No savings can be gained for the type of buildings in this facility.

3.1.4.7. Day/Night Setback.

This function will not result in any further energy savings, other than those already gained by local controls.

3.1.4.8. Lighting Controls.

The total annual lighting consumption of the buildings at Chievres Air Base and Daumerie Kaserne is 1044 MWH/YR. Experience has shown that local time clock controls will be bypassed by overriding controls in many cases and that only a centralized EMCS control function will drastically reduce lighting consumption. It will be assumed that the electrical energy savings gained by this function will be 8 percent.

3.1.4.9. Maintenance Function.

The EMCS will provide continuous information over the status of the entire systems connected to it. It will instantaneously annunciate if local control functions are in override (hand) position, if pumps or control valves are in functional operation and will save energy and maintenance effort for this reason.

Experience shows that the percentage of control panels being in override (hand) position is much higher, especially after drastic energy conservation measure such as reduction in room temperature in admin.-buildings to 18^{o} C./65^{o} F. have been implemented.

For this reason this study uses a savings constant of 5 percent for overall savings for better maintenance and monitoring capability.

3.1.4.10. Summary of Savings Constants.

FUNCTION	HEATING ENERGY	ELEC. ENERGY
Summer/Winter Operation	(Heat) 3.5%	
Optimum Start/Stop	(Heat) 0.27%	137 kWh/year/pump
		915 kWh/year/fan
Lighting Control		8 percent
Maintenance	5.0 percent	

Total Annual Savings.

Heating Energy:	8.77% of consumption
Lighting Energy:	8.0% of annual lighting
Pump Electrical Energy:	137 kWh/year/pump
Fan Electrical Energy:	1,372 kWh/year/pump

3.1.4.11. Economic Analysis.

From Tables 2-1 and 2-2, the annual fuel consumption is 45,386 million BTUs. The heating savings would therefore be:

0.0877 x 45,386 = 3,980 million BTU

The annual lighting consumption is 1044 MWHRS. The annual savings would be 0.08 x 1044 = 83,520 kWhrs.

The pumping savings would be 33 x 137 = 4,521 kWhrs.

The fan energy savings would be 24 x 915 = 21,960 kWhrs.

Total Electrical savings = 110,001 kWhrs/YR.

From the cost estimate in Appendix, the construction cost of the EMCS system is $1,567,074.

The SIR for is 0.26 and thus does not qualify for ECIP.

3.1.5. Maintenance and Repair Projects.

Maintenance and repair projects that would provide energy savings and fall below the minimum ECIP funding requirements. Modifications that would produce savings are listed in Section 3.3.

3.2. ECIP Projects Developed.

One Life Cycle Cost Analysis Summary yielded an ECIP project with an SIR greater than one (1).

Weatherization - SIR = 1.7

The Life Cycle Cost Analysis Summary and Form 1391 are included in this section.

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION: NSSG, Mons BE REGION NO. ______ PROJECT NUMBER ______

PROJECT TITLE Weatherization FISCAL YEAR 1987

DISCRETE PORTION NAME Wall and Roof Insulation

ANALYSIS DATE 1983 ECONOMIC LIFE 15 YEARS PREPARED BY LAD

1. INVESTMENT

A.	CONSTRUCTION COST	$ 944,662	
B.	SIOH (at 5.5%)	$ 51,956	
C.	DESIGN COST	$ ---	
D.	ENERGY CREDIT CALC (1A+1B+1C)X.9	$ 905,495	
E.	SALVAGE VALUE	$	
F.	TOTAL INVESTMENT (1D-1E)		$ 905,495

2. ENERGY SAVINGS (+)/COST (-)
ANALYSIS DATA ANNUAL SAVINGS, UNIT COST AND DISCOUNTED SAVINGS

FUEL	COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELEC	$		$		$
B. DIST	$ 7.12	19,849	$ 141,324	11.36	$ 1,605,450
C. RESID	$		$		$
D. NG	$		$		$
E. COAL	$		$		$
F. TOTAL		19,849	$ 141,324		$ 1,605,450

3. NON ENERGY SAVINGS (+)/COST (-)

A. ANNUAL RECURRING (+/-) $ 0
(1) DISCOUNT FACTOR (TABLE A)
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0

B. NON RECURRING SAVINGS (+)/COST (-)

ITEM	SAVINGS (+) COST (-)(1)	YEAR OF OCCURRENCE(2)	DISCOUNT FACTOR(3)	DISCOUNTED SAVINGS (+) COST (-)(4)
a.	$			$
b.	$			$
c.	$			$
d. TOTAL	$			$ 0

C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+)/COST (-) (3A2+3Bd4) $ 0

4. FIRST YEAR DOLLAR SAVINGS 2F2+3A+(3B1d/YEARS ECONOMIC LIFE) $ 141,324

5. TOTAL NET DISCOUNTED SAVINGS (2F3+3C) $ 1,605,450

6. DISCOUNTED SAVINGS RATIO (IF LESS THAN 1 PROJECT DOES NOT QUALITY)
(SIR)=(5/1F) = 1.77

7. ECIP QUALIFICATIONS TEST

A. PROJECT NON ENERGY QUALIFICATION TEST
(1) 25% MAX NON ENERGY CALC (2F3 X .33) $ 0

(2) NON ENERGY DISCOUNTED SAVINGS (3C) $ 0

(3) ENTER SMALLER OF 7.A.1 OR 7.A.2 $ ______

ESIR = (2F3 + 7A3)/1F = 1.77

IF LESS THAN 1 PROJECT DOES NOT QUALIFY FOR ECIP

IF GREATER THAN 1 THEN PROJECT QUALIFIES FOR ECIP

AND THE "SIR" GENERATED IN 6. IS REPORTED AS THE PROJECT "SIR".

1. COMPONENT	FY 19 87 MILITARY CONSTRUCTION PROJECT DATA	2. DATE
ARMY		1 MAY 1984

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
NATO Shape, Mons, Belgium	ECIP - Weatherization

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
MCA, ECIP	80000		$1255

9. COST ESTIMATES

ITEM 1 US $ = 47 BF	U/M	QUANTITY	UNIT COST	COST ($000)
Wall Type MAS1 Insulation	SF	13,339	3.62	48.3
Wall Type CON1 Insulation	SF	15,127	5.50	83.2
Wall Type CON3 Insulation	SF	5,700	3.62	20.6
Roof Type CON1 Insulation	SF	13,284	1.84	24.4
Roof Type CON2 Insulation	SF	128,968	2.22	286.3
Roof Type CON5 Insulation	SF	121,255	2.45	297.1
Roof Type ATT1 Insulation	SF	94,722	0.88	83.4
Roof Type ATT3 Insulation	SF	20,200	0.88	17.7
Roof Type ATT4 Insulation	SF	73,232	0.88	64.4
Roof Type ASB1 Insulation	SF	21,795	0.88	19.2
SUBTOTAL				944.6
Contingency (5.0 Percent)				47.2
SUBTOTAL				991.8
Cost Growth (19.9 Percent)				197.4
Total Contract Cost				1189.2
Supervision Insp. + OHead (5.5 Percent)				65.4
TOTAL REQUEST				1254.6

10. DESCRIPTION OF PROPOSED CONSTRUCTION

This project is to insulate 34,166 sq. ft. of uninsulated walls and 473,456 sq. ft. of poorly insulated roofs in 49 permanent buildings. Design is special to accommodate the differing existing wall conditions. Project will reduce load on the existing heating system. There is no air conditioning involved. All required utilities presently exist. The buildings are not located in a flood plain and no demolition is required. The handicapped will not be provided for since this project does not lend itself to design for the handicapped.

---

11. Requirement. 507,662 SF: Adequate: 0 Substandard: 507,662 SF
ECIP Project, EEAP Package 14
SIR = 1.77

Project.
Provision of wall and roof insulation of uninsulated walls and roofs and on roofs with inadequate insulation.

DD FORM 1 DEC 76 1391 · PREVIOUS EDITIONS MAY BE USED INTERNALLY UNTIL EXHAUSTED. PAGE NO.

FOR OFFICIAL USE ONLY
(WHEN DATA IS ENTERED)

3.3. Other Energy Conservation Projects Developed.

3.3.1. Maintenance and Repair Projects.

Maintenance and repair projects that would provide energy savings and fall below the minimum ECIP funding requirements are included in this Section. These projects are listed from highest to lowest SIR.

PROJECT	SEE PARA	$COST	ANNUAL SAVINGS MBTU	US$	SIR
1. Backdraft Dampers Building 3 (DK)	7.1.11	81	23.9	170	23.8
2. Backdraft Dampers Building 20 (DK)	7.1.14	27	8	56	23.6
3. Pipe Insulation	7.1.16	7,182	1,322	13,441	21.2
4. Backdraft Damper Building 6 (CAB)	7.1.6	297	40.9	291	11.1
5. Temperature Setback	7.1.2	43,247	4,455	31,719	8.3
6. Thermostatic Valves	7.1.1	16,170	2,801	19,943	8.2
7. Energy Plant Replacement	7.1.17	16,110	810	5,767	4.0
8. Delamp Building 4 (CAB)	7.1.15	6,836	64	1,137	2.0
9. Electric HWH Setback	7.1.4.1	7,547	62	1,091	1.5
10. Convertor HWH Setback	7.1.4.2	1,742	32	227	1.4
TOTAL		99,239	9,618.8	73,842	

3.3.1.1. Backdraft Dampers Building 3 (DK).

Install backdraft dampers on 3 small exhaust fans in kitchen of Building 3 at Daumerie Kaserne. The exhaust fans are not used, resulting in needless infiltration which results in increased fuel costs in the heating season.

Energy Savings:

0.35 Ft 2 x 100 Ft/Min = 35 Ft^3/Min = 35 CFM

35 CFM x 1.08 x (70-23) = 1,777 BTUH

Annual Loss = 1,777 x 3 Exhaust Fans x 6,147 x 24/(70-23) x 0.7

= 23.9 MBTU/YR

Savings to Investment Ratio Calculation.

Investment:

Construction Cost	$90
Energy Credit	- 9
Total Investment	$81
$23.9/MBTU/YR x $7.12 MBTU =	$170 Annual Savings
15 year Discount Factor =	$11.36
Discounted Savings = $170 x 11.36 =	$1,931
SIR = $1,931/$81	23.8

3.3.1.2. Backdraft Damper Building 20 (DK).

Install backdraft damper in exhaust fan of Building 20 at Daumerie Kaserne.

Energy Savings:

0.35 Ft^2 x 100 Ft/Min = 35 Ft^3/Min = 35 CFM

35 CFM x 1.08 x (70-23) = 1,777 BTUH

Annual Loss = 1,777 x 6,147 x 24/(70-23) x 0.7 = 8.0 MBTU/YR

Individual Savings to Investment Ratio Calculation.

Investment:

Construction Cost	\$ 30
Energy Credit	- 3
Total Investment	\$ 27
Annual savings = 8.0 MBTU/YR x \$7.12/MBTU =	\$56/Year
15 Year Discount Factor =	11.36
Discounted Savings = 56 x 11.36 =	\$ 636
SIR = \$636/\$27	23.6

3.3.1.3. Pipe Insulation.

The energy distribution systems for buildings heated with hot water boilers are the hot water pipe lines. The underground lines were not exposed for inspection so it was not possible to determine the condition of the insulation. By inspection of the piping in the boiler rooms, many lines have either no insulation or only partial insulation.

An analysis was made to determine the economic feasibility of insulating those bare hot water lines. The pipe line range in size from 1-1/4 to 4 inches and the insulation considered is 1-inch thick fiberglass.

Basis of Computation.

Average Pipe Temperature =	140^{o} F.
Average Boiler Room Temperature =	60^{o} F.
Average Temperature Difference (DT) =	80^{o} F.

From the Ric-Wil, Corp. Engineering Data Bulletin ED-01, the heat loss factors for horizontal bare iron pipes are as follows:

PIPE SIZE	HEAT LOSS
1-1/4 inches	1.03 (BTU/LIN. FT./^{o}F./HR.
1-1/2 inches	1.16 (BTU/LIN. FT./^{o}F./HR.
2 inches	1.41 (BTU/LIN. FT./^{o}F./HR.
2-1/2 inches	1.66 (BTU/LIN. FT./^{o}F./HR.
3 inches	2.18 (BTU/LIN. FT./^{o}F./HR.
4 inches	2.51 (BTU/LIN. FT./^{o}F./HR.

For insulated pipes, the heat loss equation is Q = DT/R

WHERE Q = Heat Loss in BTU/HR/LF of Pipe

DT = Average Temperature Difference

R = Log (E) (RO/RI)/2 * PI x K

WHERE RO = Outside Diameter of Insulation

RI = Inside Diameter of Insulation

PI = 3.14159

K = Conductivity of Insulation in BTU/HR/^{o}F./FT.

R factors were computed using actual outside diameters of pipe as follows for 1-inch thick fiberglass:

NOMINAL DIAM.	"R" FACTOR
1-1/4 inch	6.29
1-1/2 inch	5.72
2 inch	4.86
2-1/2 inch	4.20
3 inch	3.60
4 inch	2.93

Based on the above formulas and a heating annual operation time of 6552 hours, the insulation savings and costs are:

Pipe Insulation Savings

BUILDING	BARE SIZE INCHES	PIPE LENGTH FEET	PRESENT CONSUMPTION MBTU/YR	INSULATED CONSUMPTION MBTU/YR	SAVINGS MBTU/YR	COST
CHIEVRES AIR BASE						
1	2	200	147	22	125	886
2	4	100	132	18	114	646
3	4	100	132	18	114	646
6	2-1/2	50	44	6	38	239
10	1-1/2	30	18	3	15	125
24	3	50	57	7	50	258
28	2	50	37	5	32	221
29	1-1/2	50	30	5	25	208
47	2	60	44	6	38	266
52	3	100	114	15	99	517
56	3	60	69	9	60	310
DAUMERIE KASERNE						
3	3	75	86	11	75	388
4	1-1/2	30	18	3	15	125
5	1-1/2	30	18	3	15	125
7	3	100	114	15	99	517
9	3	75	86	11	75	388
13	1-1/4	30	16	2	14	120
13	2	30	22	3	18	133
18	2-1/2	60	52	7	45	287
24	2-1/2	60	52	7	45	287
STERREBEEK SCHOOL						
A	2-1/2	60	52	7	45	287
A	4	100	132	18	114	646
E	2	40	30	4	26	177
HOOGBUUL STORAGE FACILITY						
14	2	40	30	4	26	177
TOTALS					1,322	7,979

Savings to Investment Ratio Calculation Investment.

Construction Cost	\$ 7,979
Energy Credit	- 797
Total Investment	\$ 7,182
15 Year Discount Factor =	11.36
Discounted Savings = \$13,441/YR x 11.36 =	\$152,690
SIR = \$152,690/\$7,182	21.2

3.3.1.4. Backdraft Damper Building 6 (CAB).

Install backdraft dampers in each of two exhaust fans in Building 6, Chievres Air Base. The exhaust fans are not used in the winter, insulting in needless infiltration which results in increased fuel costs in the heating season.

Energy Savings.

Infiltration = 3 FT x 3 FT x 100 FT/Min = 900 FT^3/Min = 900 CFM

900 CFM x 1.08 x (70-23) = 45,684 BTUH/Exhaust Fan

Annual Loss = 45,684 x 2 Exhaust Fans x 6,147 x 24/(70-23) x 0.7

= 40.9 MBTU/YR

Savings to Investment Ratio Calculation.

Construction Cost	$310 (Total)
SIOH (6.5%)	20
Design Cost	0
Subtotal	$330
Total Investment	$297
40.9 MBTU/YR x $7.12/MBTU =	$291 Annual Savings
15 year Discount Factor =	$11.36
Discounted Savings = 291 x 11.36 =	$3,305
SIR = $3,305/$297 =	11.1

3.3.1.5. Temperature Setback.

Hot water reset controllers save energy by supplying to the space only the heat required as dictated by the outside air temperature. In the case of hot water radiation systems, as the outside air temperature varies, the supply water temperature will also vary in inverse proportion to supply only sufficient heat energy to offset the building heat losses at that outside air temperature. Setback controllers will reduce energy consumption by reducing space temperature at night as well as during unoccupied periods.

In buildings with air handling units with individual room thermostats, setback may be accomplished by replacing the existing thermostats with automatic 7-day setback thermostats. In buildings which are heated with radiators, the hot water temperature is set back during unoccupied periods by means of setback controllers being fitted on hot water boilers that currently have no energy conservation features.

Savings to Investment Ratio Calculation.

Investment at $1,000/boiler and $300 per air handler.

Construction Cost	$44,700
SIOH (6.5%)	2,905
Design Costs	447
Subtotal	$48,052
Energy Credit	- 4,805
Total Investment	$43,247

Energy Savings:

$7.12/MBTU x 4,455 MBTU =	$31,719	Annual
Savings		
15 year Discount Factor =	$11.36	
Discounted Savings = $31,719 x 11.36	$360,327	
SIR = $360,327/$43,247 =	8.3	

Buildings w/Opportunity for Night & Weekend Space Temperature Setback.

Those buildings with opportunity for night and weekend temperature setback are listed as follows:

Setback Savings, Chievres

BLDG	FUNCTION	BASELINE CONSUMPTION MBTU/YEAR	SET BACK CONSUMPTION MBTU/YEAR	SET BACK SAVINGS MBTU/YEAR	SET BACK SAVINGS $/YEAR	COST	SIR
04	POST EXCH.	3,020	1,933	1,087	7,742	2,200	23.37
05	COMMISSARY	2,868	1,835	1,032	7,351	1,300	37.56
10	FIRE STATION	731	468	263	1,875	1,300	9.58
27	BASE OPER.	268	171	96	687	300	15.21
28	BASE OPER.	271	174	97	697	1,000	2.64
29	PROP.BOOK OFF.	272	174	98	698	1,000	4.64
30	VET.CLINIC	190	121	68	487	300	10.78
32	FURN.STORE	322	206	115	825	1,000	5.48
33	MULTI-USE	199	127	71	512	3,000	1.13
47	OIC,LOG.PROV.M	658	421	237	1,688	1,000	11.21
56	CONTROL TOWER	883	565	317	2,263	1,000	15.03
01	ADMIN. & JAIL	384	303	80	575	3,000	3.11
02	XMTR	208	164	43	311	3,000	1.68
03	REC. CTR.	500	500				1.00
04	LGM MAINT.	187	187				1.00
05	F.E.MAINT.	301	301				1.00
07	COMM. CTR.	1,065	841	223	1,592	1,300	19.87
08	COMP.& EDU.CTR	860	679	180	1,286	3,000	6.95
09	COMM.COUNSEL	177	140	37	265	3,000	1.43
10	DENTAL CLINIC	588	464	123	879	3,000	4.75
11	OIC CAD D/LOG.	200	158	42	299	3,000	1.61
13	CHAPEL	777	777				1.00
14	DET 2,1964CG	218	218				1.00
15	ARMY COMM.SERV	283	224	59	424	3,000	2.29
16	TECH.CONTROL	213	168	44	319	3,000	1.72
18	128 SIG.DET.HQ	303	303				1.00
22	CHIEFS SUPPLY	194	153	40	290	3,000	1.57
24	EMERG.BILLIT	939	836	103	735	3,000	3.97

3.3.1.6. Thermostatic Valves.

Generally, manual radiator valves are used in buildings heated with radiators. This type of heating control does not rely on a temperature measurement within the space, but instead is left to the occupants.

Often, instead of closing the valve when the room starts to overheat, the occupant will open the windows. Control valves provide a much better means of regulation by automatically opening and closing as required to meet the space heating load.

Costs and savings are based upon an 8-year life because it is assumed that the valves will be defective at the end of eight (8) years.

Savings to Investment Ratio Calculation.

Investment at $26/Valve:

Construction Cost	$ 16,870
SIOH (6.5%)	1,097
Design Costs	0
Subtotal	$ 17,967
Energy Credit	- 1,797
Total Investment	$ 16,170

Energy Savings:

$7.12/MBTU x 2,801 MBTU =	$ 19,943 Annual Savings
8-Year Discount Factor =	6.64
Discounted Savings =	$ 19,943
	x 6.64
	$132,422
SIR = $132,422 divided by $16,170 =	8.2

Buildings with Manual Radiator Valves.

Those buildings which utilize radiators with manual valves and would benefit economically from the installation of thermostatic valves are listed as follows:

Thermostat Savings, Chievres

BLDG	FUNCTION	PRESENT CONSUMPTION MBTU/YEAR	THERMOSTAT CONSUMPTION MBTU/YEAR	THERMOSTAT SAVINGS MBTU/YEAR	THERMOSTAT SAVINGS $/YEAR	COST	SIR
32	FURN.STORE	322	273	48	343	672	3.39
47	OIC,LOG.PROV.M	658	559	98	703	672	6.95
52	BODY SHOP	1,624	1,380	243	1,734	420	27.44
56	CONTROL TOWER	883	750	132	943	1,218	5.14
TOTALS				523	3,725	2,982	8.30

Thermostat Savings, Daumerie

BLDG	FUNCTION	PRESENT CONSUMPTION MBTU/YEAR	THERMOSTAT CONSUMPTION MBTU/YEAR	THERMOSTAT SAVINGS MBTU/YEAR	THERMOSTAT SAVINGS $/YEAR	COST	SIR
01	ADMIN. & JAIL	452	384	67	483	1,428	2.24
02	XMTR	244	208	36	261	840	2.06
09	COMM.COUNSEL	208	177	31	222	630	2.34
10	DENTAL CLINIC	691	588	103	738	1,428	3.43
16	TECH.CONTROL	251	213	37	268	378	4.72
18	128 SIG.DET.HQ	282	240	42	301	420	4.77
19	DIAL CENT.OFF.	266	226	39	284	420	4.50
20	COMMUN. CTR.	971	825	145	1,037	1,512	4.55
22	CHIEFS SUPPLY	228	194	34	244	336	4.82
24	EMERG.BILLIT	1,105	939	165	1,180	1,554	5.04
TOTALS				705	5,024	2,982	11.6

Thermostat Savings, Sterrebeek

BLDG	FUNCTION	PRESENT CONSUMPTION MBTU/YEAR	THERMOSTAT CONSUMPTION MBTU/YEAR	THERMOSTAT SAVINGS MBTU/YEAR	THERMOSTAT SAVINGS $/YEAR	COST	SIR
A	ADMIN.	1,509	1,282	226	1,611	2,100	5.09
B	HIGH SCHOOL	1,049	891	157	1,120	2,436	3.05
C	GRADE SCHOOL	1,049	891	157	1,120	2,436	3.05
D	GYMNASIUM	713	606	106	761	462	10.95
E	HEALTH CLINIC	566	481	85	605	2,772	1.45
TOTALS				733	5,219	10,206	3.39

3.3.1.7. Energy Plant Replacement.

The oil-fired boilers and air handling units in most of the buildings are in fair to good condition. However, in several buildings the units are in poor condition and should be replaced. At Chievres Air Base, the units that need to be replaced are the oil-fired air handling units serving the east offices in Building 6, the oil-fired air handling units in Buildings 22 and 23, and the boilers in Buildings 47 and 52. At Daumerie Kaserne the boilers in Building 5 and 6 should be replaced. For the Economic Analysis, the existing and new (replacement) plant efficiencies have been estimated as follows:

OIL-FIRED AIR HANDLING UNITS	EXISTING	NEW
• Combustion Efficiency	65 Percent	80 Percent

OIL-FIRED BOILERS	EXISTING	NEW
• Combustion Efficiency	65 Percent	80 Percent
• Jacket Losses	3 Percent	1 Percent
• Scale Build Up	6 Percent	1 Percent
• Standby Losses	5 Percent	5 Percent
• Header/Valve Losses	1 Percent	1 Percent
TOTAL PLANT EFFICIENCY	50 PERCENT	72 PERCENT

Central plant replacement costs, savings and annual building heating loads have been calculated on the basis of the building having been insulated, provided with night setback controls, and in the case of hot water heated buildings, thermostatic radiator valves.

Central Plan Savings

BUILDING	ANNUAL HEAT LOSS MBTU	PRESENT CONSUMPTION MBTU	REPLACEMENT CONSUMPTION MBTU	SAVINGS MBTU/YEAR	COST
CHIEVRES AIR BASE					
6	75	115	94	21	1,100
22	248	381	310	71	1,600
23	221	340	276	64	1,600
47	184	368	255	113	2,800
52	403	806	560	246	4,000

DAUMERIE KASERNE					
5	74	148	103	45	2,800
6	409*	818	568	250	4,000
				810	17,900

* Heat loss for Building 24 which is heated by boiler in Building 6.

Savings to Investment Ratio Calculation

Construction Cost	$17,900
Energy Credit	- 1,790
Total Investment	$16,110
15 Year Discount Factor =	11.36
Discounted Savings = $5,767/YR x 11.36 =	$65,513
SIR = $65,513/$16,110	4.0

3.3.1.8. Delamp Building 4 (Chievres Air Base).

This building has five (5) tube fluorescent fixtures. If the fixtures were cleaned and relamped, one (1) tube and ballast could be removed.

Cost:

Lamps	$1,976
Labor	$4,860
Total	$6,836

Savings:

50 watt x 162 lamps x 2,340 HRS/YR = 18,954 KWHR at $.06/KWHR Savings

= 18,954 x .06 = 1,137/YR

Discounted Savings = $1,137 * 11.01 = $12,518

SIR = 12,518/(6,836 * .9) = 2.0

3.3.1.9. Setback of Domestic Hot Water Temperature.

The domestic hot water temperature can be set back with time clock controls at night and during unoccupied periods to save energy. The calculations are based on setting back the temperature from 120° F. (49° C.) to 80° F. (27° C.) with an average inside air temperature of

70^{o} F. (21^{o} C.). The electric water heaters have a surface area of 25 Ft^2 and the convertor types have a surface area of 70 Ft^2. Since the buildings are occupied an average of 9 hours per day, 5 days per week, the buildings are unoccupied on an average of 6,396 hours/year. The "U" values for the electric and convertor type heaters have been calculated to be 0.37 BTU/HR·$FT^{2o}F$. respectively.

Those buildings utilizing electric hot water heaters include:

Chievres Air Base:	1, 2, 3, 4(2), 5, 9, 10, 12, 24, 27, 28, 29, 30, 33, 34, 47, 52, and 56.
Daumerie Kaserne:	2, 11, 15, 16, 19, and 20.
Hoogbuul Storage Facility:	14
Total Quantity:	26

Energy Savings (Unoccupied Hours).

Existing Tank Losses = 25 x 0.37 x (120-70) x 6396 x 26 = 77 MBTU/YR

Setback Tank Losses = 25 x 0.37 x (80-70) x 6396 x 26 = 15 MBTU/YR

Accounting for 100% electric efficiency.

Savings = 62 MBTU/YR

Savings to Investment Ratio Calculation.

Construction Cost $300 x 26 =		$ 7,800
SIOH (6.5%)	507	
Design Costs	78	
Subtotal	$ 8,385	
Energy Credit	- 838	
Total Investment	$ 7,547	
Annual Savings = 62 MBTU/YR x $17.6/MBTU =		$ 1,091/YR
15 Year Discount Factor =	11.01	
Discounted Savings = 1,091 x 11.01 =		$12,011
SIR = $12,011/$7,547 =	1.5	

3.3.1.10. Convertor Hot Water Heaters.

These heaters are shell and tube type convertors with oil-fired hot water as the heat source. The buildings utilizing convertor hot water heaters are:

Chievres Air Base:	6 and 52
Daumerie Kaserne:	7,9, and 18
Hoogbuul Storage Facility:	A
Total Quantity:	6

Energy Savings (Unoccupied Hours).

Existing Tank Losses = 70 x 0.21 x (120-70) x 6396 x 6 = 28 MBTU/YR

Setback Tank Losses = 70 x 0.21 x (80-70) x 6396 x 6 = 5 MBTU/YR

Accounting for 70% oil efficiency.

Savings = (28-5)/0.7 = 32 MBTU/YR

Savings to Investment Ratio Calculation.

Construction Cost $300 x 6 =	$ 1,800
SIOH (6.5%)	117
Design Costs	18
Subtotal	$ 1,935
Energy Credit	- 193
Total Investment	$ 1,742
Annual Savings = 32 MBTU/YR x $7.12/MBTU =	$227/YR
15 Year Discount Factor =	$11.36
Discounted Savings = 227 x 11.36 =	$ 2,578
SIR $2,578/$1,742 =	1.4

3.3.1.11. Duct Repair.

Repair broken supply duct in Building 4 at Chievres Air Base. In its present condition, approximately 200 CFM of heated air is being dumped in this building. Besides overheating the space in which the break occurs, other zones served by the same supply fan are being deprived of heat they could be utilizing.

Because the cost of such a repair would be minimal, any calculation or savings to investment ratio would be superfluous. It is recommended that this repair be done out of maintenance funds to increase occupant comfort and conserve energy.

3.3.1.12. Rebalance.

Rebalance supply air registers in garage of Building 10 at Chievres Air Base. Building 10 is a fire station and as such houses fire trucks in the garage. The garage is heated to facilitate quick starting maintenance. Presently, space temperature varies due to the fact that some areas are overheated and some underheated. By rebalancing, occupant comfort may be increased and thermostatic action will be more accurate, resulting in some energy conservation. This ECO will have minimal cost and should be performed as a routine maintenance item.

3.3.1.13. Remove Blockage.

Remove storage materials blocking return air grilles in Building 30 of Chievres Air base.

By obstructing the return air path of the fan system, the location of these storage items may be increasing the supply fan electrical demand. In addition, the fan may be pulling unheated air from the room in which it is located rather than recirculated conditioned air resulting in an increased space heating load.

The cost of the ECO is minimal and should be performed as a routine maintenance item.

3.3.1.14. Rebalance Building 33.

Rebalance supply air system in Building 33 of Chievres Air Base.

Presently, space temperature varies due to the fact that some areas are overheated and some underheated by rebalancing, occupant comfort may be increased and thermostatic action will be more accurate, resulting in some energy conservation.

This ECO will have minimal cost and should be performed as a routine maintenance item.

3.3.1.15. Turn Off Heat.

Turn off heat during periods when Buildings 1, 7, and 2A at Daumerie Kaserne are vacant. The buildings are presently vacant most of the year but the heat remains on. This is a no cost energy conservation measure which should be instituted immediately. The domestic water systems are drained to prevent freezing.

3.3.1.16. Repair Building 7.

Repair air handling unit return air duct in Building 7 at Daumerie Kaserne.

Presently, the return air duct is open to the unheated attic, imposing an additional heating load on the space during air handling unit operation.

This ECO will have minimal cost and should be performed as a routine maintenance item.

3.3.1.17. Setback Temperature.

Manually setback space temperature of Building 13 at Daumerie Kaserne during unoccupied periods. This building is presently occupied only one hour per week, but the heat remains on when unoccupied. This is a no cost energy conservation measure which should be instituted immediately.

3.3.2. Previous Energy Studies.

No previous energy studies have been performed on this facility.

3.3.3. Operational Improvements.

Operation improvement recommended was termination of parking of FE vehicles indoors.

3.3.4. Previously Implemented Energy Projects.

The following projects have already been implemented:

FY 78: Installation of timers on heating plants.

FY 79: Photo-electric control on street and security lighting.

FY 79: Delamping.

FY 76: Installation of capacitors at Chievres and Sterrebeek.

FY 76: Installation of false ceiling in Hangar No. 3.

FY 78: Heating system modification in Hangar No. 6.

FY 79: Replaced boilers at Sterrebeek.

FY 82: Replaced metal siding with insulated panels on eight (8) buildings at Chievres.

FY 79: Installation of false ceiling in Building 15, Daumerie.

FY 80: Installation of false ceiling in Building 11, Daumerie.

FY 82: Replaced skylights in Buildings 1, 2, 3, 4, and 5, Chievres.

3.3.5. Future Development Plans.

The following changes in occupancy and planned new facilities have been recommended. Increases in energy consumption have been estimated.

Daumerie Kaserne

At the present time Buildings 1, 7, 21, and 24 are reserved for use only during SHAPE exercises. Building 3, 6, and 25 are used for storage. Occupancy will change as follows:

BLDG NO	PRESENT USE	FUTURE USE	HEATING MBTU	ELEC KWHRS
3	Recreation	Enlisted Mess	0	24,000
6	Storage	Administration	250	40,000
7	Storage	Officers Mess	0	40,000
24	Storage	Barracks	0	200,000
25	Storage	Barracks	150	36,000
		TOTAL	400	340,000

NEW FACILITIES:

USE	SQUARE FEET	HEATING MBTU	ELECTRICITY KWHRS
Morale Support Activity	2,000	100	12,000

Total Increase in Energy Consumption at Daumerie:

Heating: 500 MBTU

Electricity: 352,000 KWHRS

Increase in Square Footage

New:	2000
Use of Vacant:	26,000
Total:	28,000 SF

Chievres Air Base.

NEW FACILITIES:

USE	GROSS AREA SQUARE FEET	HEATING MBTU	ELECTRICITY KWHRS
Training Facility	6,600	330	40,000
Laundromat	5,000	250	65,000
Commissary Storage	3,083	100	4,500
AAFES Portacabins	2,500	125	25,000
4 Seasons Storage	1,600	48	1,600
F.E. Store House	10,860	32	10,000
F.E. Office Space	1,954	57	16,000
Supply Building	1,500	45	1,500
Furniture Store	4,040	200	40,000
Exchange Office	1,500	75	15,000
Exchange Auto Repair	3,250	190	30,000
Post Office	1,000	50	6,000
Beauty Shop	1,500	75	15,000
Bottle Shop	1,676	84	15,000
Vet Lab	1,500	75	9,000
Hangar	7,200	215	10,000
Operations Building	4,060	200	25,000
Avionics Shop	600	36	6,000
Aircraft Parts Storage	4,000	120	4,000
Dog Kennell	1,000	30	8,000
TOTAL	64,417	2,337	346,100

Steerebeek School.

NEW FACILITIES:

USE	GROSS AREA SQUARE FEET	HEATING MBTU	ELECTRICITY KWHRS
Chapel	3,600	100	1,500
Dental Storage	600	20	1,000
Maintenance	500	25	4,500
Racquetball Court	1,200	50	3,600
TOTAL	5,900	195	10,600

Hoogbuul.

NEW FACILITIES:

USE	GROSS AREA SQUARE FEET	HEATING MBTU	ELECTRICITY KWHRS
Lunchroom	1,700	80	10,200
Administration Building	2,200	110	16,500
Maintenance Building	5,613	300	11,200
TOTAL	9,513	490	37,900

NSSG (US) Increases (Total).

	AREA SQFT	HEATING MBTU	ELECTRICITY MWHRS	TOTAL ENERGY MBTU
Daumerie	2,000	500	352	4,583
Chievres	64,417	2,337	346	6,350
Steerebeek	5,900	195	11	323
Hoogbuul	9,513	490	38	931
TOTAL	81,830	3,522	747	12,187

3.3.6. Increment 'G'.

No Increment 'G' projects were identified at this community.

3.3.7. Other Energy COnservation Opportunities Examined.

3.3.7.1. Metering.

No buildings were identified where the addition of metering might be expected to reduce energy consumption.

3.3.7.2. Solar Energy.

This region of Europe is normally overcast during much of the year. Investigation of the use of solar energy is not warranted.

3.3.7.3. Inoperative Controls.

No inoperative controls were found.

3.3.7.4. District Heat.

There is no District Heating System available to the facility.

3.3.7.5. Non-Qualifying Projects.

Many energy conservation opportunities were considered and discarded either due to poor financial pay back or because mandatory considerations (Appendix B to Statement of Services) were inapplicable to the facility.

For example, in all areas surveyed that were heated with unit heaters, the heaters were controlled with switches that had to be manually turned on and off. All of these spaces were being kept at 60° F. (16° C.) or lower, so the installation of space thermostats would not yield any economic benefits. The heat is only turned on if someone is too cold and in almost all areas no one was turning on the heat.

3.3.7.6. Insulating Glass.

Replacement of single pane with double pane glass had an SIR less than one (1).

3.3.7.7. Insulation of Walls.

Insulation of uninsulated walls and roofs is included in Weatherization ECIP. Many buildings had walls and roofs that did not meet SIR criteria are listed in the Energy Report.

3.3.7.8. Zone existing multiple use facilities to reduce energy consumption in minimal use areas.

This has been accomplished.

3.3.7.9. Reschedule utilization of existing facilities.

This is not feasible.

3.3.7.10. Consolidate services into permanent buildings through alteration or new construction.

This is included in future development plan.

3.3.7.11. Connect to district heating in order to purchase or sell energy.

No district heating is available.

3.3.7.12. Interconnect existing power plants.

Not feasible.

3.3.7.13. Consolidate existing power plants where forecastable non-recurring maintenance costs can be demonstrated.

Boiler has been refurbished by community.

3.3.7.14. Convert to more energy efficient fuels.

In progress by community.

3.3.7.15. Return condensate.

All condensate is returned.

3.3.7.16. Convert existing energy distribution systems to utilize more efficient medium.

Steam systems converted to hot water.

3.3.7.17. Recover heat from processes such as boiler blowdown, refrigerant gas, exhaust air from laundries and messhalls, destratification of air.

See Section 3.3.1.

3.3.7.18. Supplement the generation of domestic hot water through installation of a heat pump.

No air conditioning is installed in buildings using hot water.

3.3.7.19. Decentralize domestic hot water heaters.

They are decentralized.

3.3.7.20. Curtail availability of energy to domestic hot water heaters.

Accomplished where possible.

3.3.7.21. Install shower flow restrictors.

Partially completed.

3.3.7.22. Improve street lighting efficiency by delamping (reduction of lighting level) or replacement with low or high pressure sodium.

Street lighting has been programmed by community.

3.3.7.23. Relamp with fluorescent, H.P. sodium or other more energy efficient lighting.

Programmed.

3.3.7.24. Control light levels automatically.

Variation in external luminance is insufficient to warrant automatic adjustment.

3.3.7.25. Utilize photocell switches.

Programmed.

3.3.7.26. Employ spot heating in lieu of existing unit heaters.

Spot heating is not applicable to function.

3.3.7.27. Individual versus stairwell or area metering of military family housing.

There is no family housing.

3.3.7.28. Recommended preventive maintenance program procedures for high efficiency motor replacement.

There are no low efficiency motors.

3.3.7.29. Install storm or energy efficient windows, double glaze existing windows, reduce window area, install translucent panels, upgrade by replacement, install thermal barriers, modify skylights.

Not economically feasible.

3.3.7.30. Replace existing doors, install vestibules, air curtains and load dock seals.

New doors have been programmed where economically feasible.

3.3.7.31. Study the feasibility of peak demand shedding.

See Section 3.1.4.

3.4. Recommendations, Policy Changes and Actions.

3.4.1. Recommendations and Policy Changes.

In addition to the ECIP project and the projects specifically identified in Section 3.3.1., there are a number of projects identified that will save energy that have little or no cost to implement. These opportunities are identified in Sections 3.3.1.11. to 3.3.1.17. and should be pursued.

3.4.2. Actions

The ECIP and Maintenance & Repair projects should be implemented. Non-Cost Energy Conservation Opportunities should be accomplished as time is available.

4. ENERGY AND COST SAVINGS

4.1. Energy Consumption Forecast

Future consumption of energy will change due to increased use of existing facilities and new facilities planned in the Future Development Plan. Consumption will decrease due to implementation of projects included in this report.

Assuming that energy conservation projects are implemented by Spring 1988, the first fiscal year to show the results of the projects would BE FY 89 when heating fuel consumption would be reduced from the present level of 62,719 MBTu to 33,251. This would be a reduction of 47 percent. Electricity would be reduced by only 37 MWHR per year from 4644 to 4607 MWHR. Total energy consumption would be 866,992 MBTU. Consumption per square foot would be 130,562 MBTU.

If all future development plan projects are implemented and MCA projects are approved and proceed on the same schedule, FY 1989 consumption would be:

Natural Gas: 33,251 + 3522 = 36,773 MBTU/YR

Electricity: 4,607 + 747 = 5,354 MWHRS

Total Energy = 5354 * 11.6 + 36,773 = 98,880 MBTU

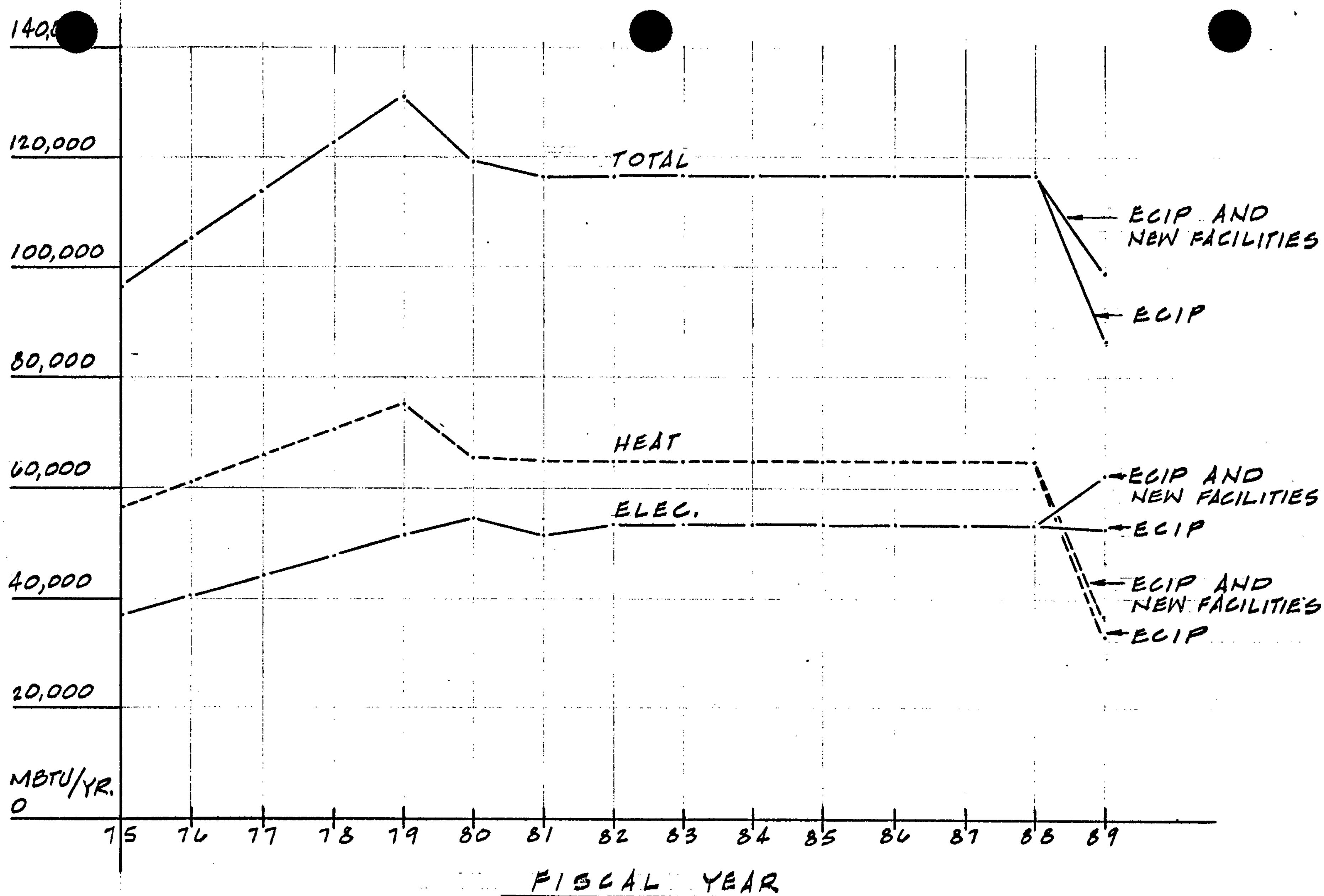
Total Consumption/SQFT = 98,880/771/808 = 128,115 BTU/SF

Previous years consumption along with the two possibilities are shown in the following table:

Total Energy Consumption, NSSG (US)

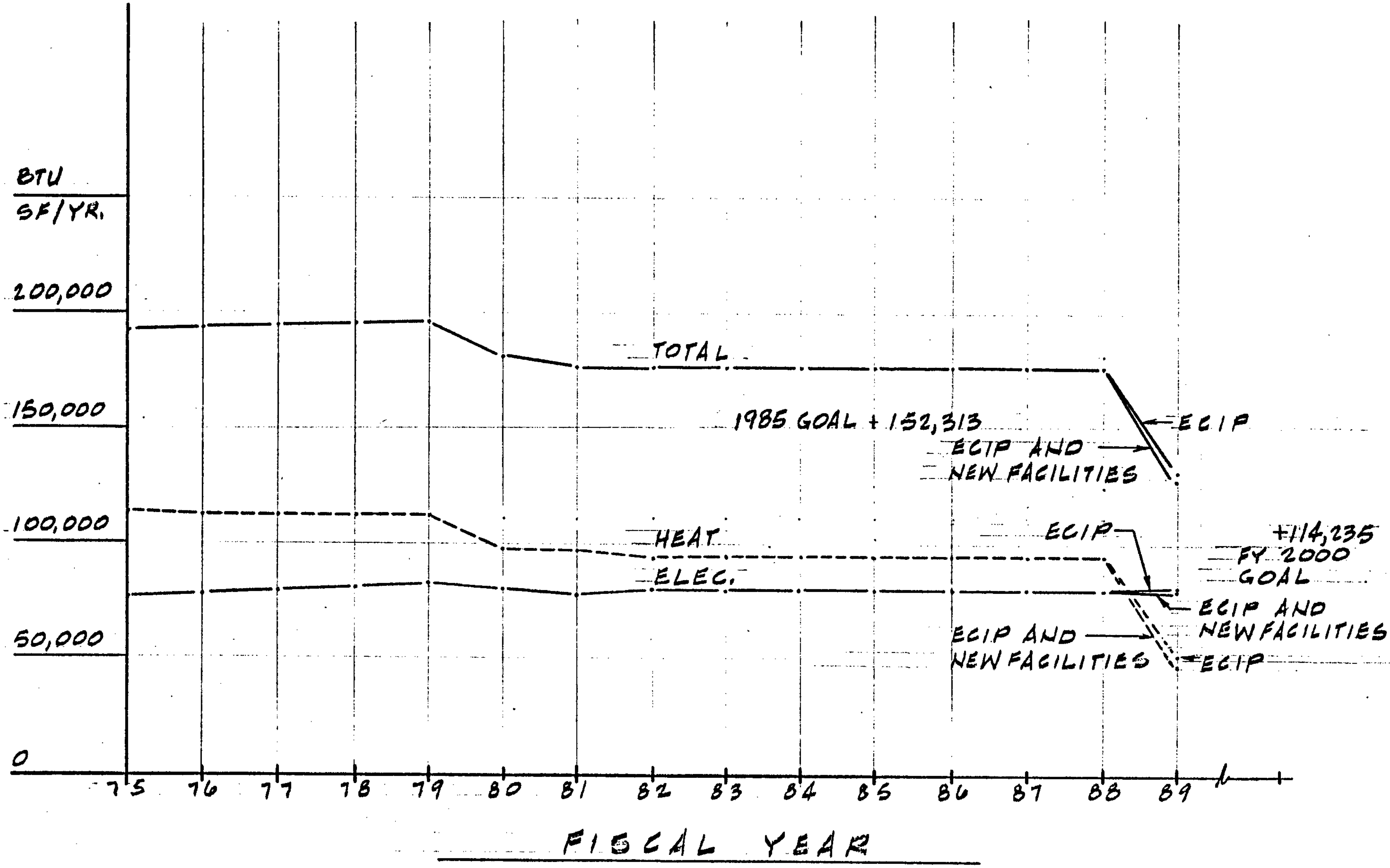
FISCAL YEAR	ELECTRICITY MBTU	HEAT MBTU	TOTAL MBTU	AREA SF	CONSUMPTION BTU/SF
75	38,512	58,420	96,932	509,118	190,392
79	55,942	74,573	130,515	663,988	196,562
80	54,415	65,223	119,638	663,988	180,180
81	51,720	64,606	116,326	663,988	175,192
82	53,870	62,719	116,589	663,988	175,589
--- ASSUME CONSTANT THRU 1988 ---					
89	53,441	33,251	86,692	663,988	130,562
or					
89	62,107	36,773	98,880	771,808	128,115

These data are plotted in Figures 4-1 and 4-2.



ENERGY CONSUMPTION NSSG (US)

Figure 4-1.



ENERGY/SQUARE FOOT CONSUMPTION NSSG (US)

Figure 4-2.

4.2. Forecast Energy Savings

Assuming that the energy conservation projects are implemented, the FY 89 heating fuel consumption would be reduced from the present level of 62,719 MBTU/YR to 33,251 or a savings of 29,468 MBTU/YR. This would be a savings of 47 percent. Electricity consumption savings would only be 37 MWHR/YR from 4,644 to 4,607 MWHR/YR. Total energy savings would be 29,897 MBTU/YR.

4.3. ECIP Projects.

PROJECT DESCRIPTION	COST	ANNUAL SAVINGS MBTU	$US	SIR
Weatherization Walls & Roofs	905,495	19,849	141,324	1.77

4.4. Projected Utility Costs.

It was not possible to obtain a forecast of utility cost. Costs used in the economic analysis were accounted for by using "Modified" uniform present worth discount factors included in ECIP guidance dated 18 February 1983.

4.5. Schedule of Energy Conservation Projects.

4.5.1. ECIP Projects.

PROJECT DESCRIPTION	COST	ANNUAL SAVINGS MBTU	$US	SIR
Weatherization Walls & Roofs	905,495	19,849	141,324	1.77

4.5.2. Maintenance and Repair Projects

PROJECT	SEE PARA	$COST	ANNUAL SAVINGS MBTU	ANNUAL SAVINGS US$	SIR
1. Backdraft Dampers Building 3 (DK)	7.1.11	81	23.9	170	23.8
2. Backdraft Dampers Building 20 (DK)	7.1.14	27	8	56	23.6
3. Pipe Insulation	7.1.16	7,182	1,322	13,441	21.2
4. Backdraft Damper Building 6 (CAB)	7.1.6	297	40.9	291	11.1
5. Temperature Setback	7.1.2	43,247	4,455	31,719	8.3
6. Thermostatic Valves	7.1.1	16,170	2,801	19,943	8.2
7. Energy Plant Replacement	7.1.17	16,110	810	5,767	4.0
8. Delamp Building 4 (CAB)	7.1.15	6,836	64	1,137	2.0
9. Electric HWH Setback	7.1.4.1	7,547	62	1,091	1.5
10. Convertor HWH Setback	7.1.4.2	1,742	32	227	1.4
TOTAL		99,239	9,618.8	73,842	

5. SUMMARY AND CONCLUSION

5.1. Summary

The purpose of this study is to identify and financially evaluate all possible means to reduce energy consumption in compliance with the objectives set forth in the Army Facilities Energy Plan. During the first phase of the study, the NSSG (US) facilities were physically surveyed. This report addresses, possible energy conservation measures that should be implemented. NSSG (US) has eight (8) installations and two (2) major lease holdings. Seven (7) installations and one leased facility are located in south and central Belgium and one installation and one leased facility are in the Rotterdam area of the Netherlands. Only four (4) of NSSG's installations are included in this study. These are BE 010 Chievres Air Base, BE 015 Daumerie Kaserne, BE 020 Sterrebeek Dependent School, and BE 031 Hoogbuul Storage Facility. All heating at the four locations surveyed utilized fuel oil. Hoogbuul and Sterrebeek each have a single electric meter. At Chievres, one electric meter serves the PX and Commissary activities. Another meter serves the remainder of Chievres Air Base and Daumerie Kaserne. In FY 82, NSSG (US) purchased approximately US $700,000 worth of electricity and fuel oil at the 4 locations surveyed. This represents approximately US $1 per gross square foot of space. Fuel oil consumed was 426,688 US GAL or 62,719 million BTU or (122,000 BTU/SF of heated space). Electricity use amounted to 4,644,006 KWHRS or 53,870 million BTU. (81,129 BTU/SF)

Analysis of the energy conservation opportunities investigation resulted in the following projects:

Weatherization of Walls and Roofs - SIR = 1.7

Maintenance and Repair Projects - SIR greater than 1.0

5.2. Conclusions

The Weatherization Project and the Maintenance and Repair Project should be implemented.

The non-cost energy opportunities should be implemented with maintenance personnel.

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
P.O. BOX 9005
CHAMPAIGN, ILLINOIS 61826-9005

REPLY TO
ATTENTION OF: TR-I Library

17 Sep 1997

Based on SOW, these Energy Studies are unclassified/unlimited. Distribution A. Approved for public release.

Marie Wakefield,
Librarian Engineering